

THE VARIEGATED TINAMOU¹

Crypturus variegatus variegatus (Gmelin)

BY WILLIAM BEEBE

Contributions to the Life History and Anatomy
of the Birds of Kartabo, Bartica District
British Guiana

Besides the life history, my object in this résumé of certain characters of the birds of Kartabo, is to present a study of the hyoid and of the syrinx, combined and correlated with the voice itself. I have supplemented this with other characters which Ridgway and Chubb have necessarily been compelled to give inaccurately from dried skins, such as total length, or have quite omitted, as extent, weight, tongue, hyoid, the fresh, unshrunk tarsus, etc.

THE VARIEGATED TINAMOU

Crypturus variegatus variegatus (Gmelin)

(Plates A-B; Figs. 18-22 incl.)

Type Description: *Tetrao variegatus*, Gmelin, Syst. Nat. I. 1788, p. 768 (Gujana).

Names: *Colonial*; Small Maam, Mamoo Swagger. *Akawai*; Orri-orri.

Field Characters: Medium-sized tinamou; head dark; upper parts, wings and sides black, narrowly barred with buff; neck all around and breast chestnut; chin, throat and abdomen white.

Haunts: Floor of the jungle, rarely coming to the bank of the rivers, and never into clearings. I have found them both in low, almost swampy spots, and on high, dry, sandy ridges.

Abundance: Second to *Tinamus major*, and away from the rivers probably exceeding it in numbers. Within the research zone of a quarter square mile at Kartabo, I have counted, with no duplication, the calls of sixteen individuals in the course of an hour's continuous walk.

Home Range: By means of slight peculiarities in the call-notes, I have been able in two instances, to locate with certainty the home range of the Variegated Tinamou. One bird, a female as it ulti-

¹Contribution, Department of Tropical Research No. 191.

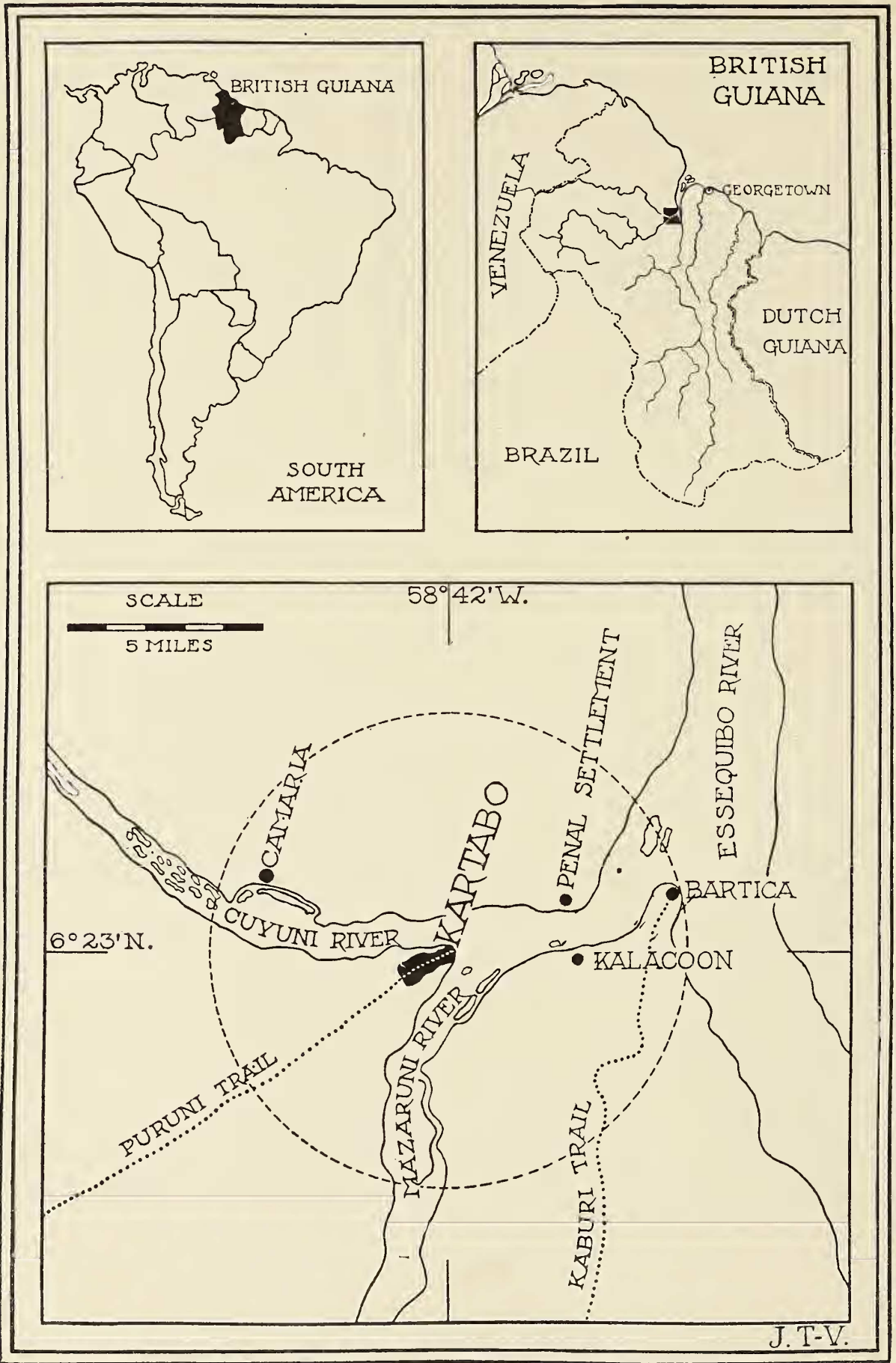


Plate A. British Guiana Tropical Research Station of the New York Zoological Society.
The circle represents a radius of six miles.

mately proved, was always to be found in one of two small snarls of lianas and underbrush within the hundred foot square of AA₂₆. Any time during the night the bird could be flushed from this spot. In the morning about 5:30 she began calling, timidly at first, then with more assurance. As it grew light she left her retreat and moved slowly west across one of our trails and then turned south to several trees with fallen fruit. Here the calling ceased for about half an hour and then recommenced as she retraced her steps, turned west again and went on until I lost her in the maze of thick jungle. Her last call was given about seven o'clock. During the period of a full month she followed this identical routine every one of the eighteen mornings on which I trailed her, with a single change to a new feeding ground when the supply from the first gave out. On five evenings I found her back in the brush pile, when she began a new period of calling, usually beginning about 5:15 and continuing intermittently until nearly seven o'clock. A third period is often marked among these birds, from nine to ten P.M.

Geographic Distribution: This form of tinamou extends to Venezuela and north Brazil.

Sociability: These birds are decidedly solitary, found together only by accident for an hour or two when feeding under the same tree, and for little longer when the mating takes place.

Specific Individuality: The partridge-like gait is like that of other tinamou; the flight is sudden, noisy and direct. It is wary even when never shot at, and suspicious of any unusual sight or sound.

Intercommunication: The calls I have described in "*Tropical Wild Life*," p. 268. An important addition is the preliminary note. Before the beginning of the regular staccato trill, a single, high, sweet, long-drawn-out note is uttered, of about two seconds' duration, followed by an interval of three or four seconds, when the call proper is given. Rarely, when the bird becomes suddenly suspicious, the first note is given alone, but almost invariably it is the precursor of the call. Once I heard a low *chuck! chuck!* uttered by a male with a half-grown chick in tow. When the birds rise they are always silent, unlike pheasants, no matter how terrified they may be. On moonlit nights I have heard their usual call at intervals throughout the night, on cloudy days it is sometimes uttered at noon, while during no month of the year is the Variegated Tinamou wholly silent. It is, of course, always given from the ground, and probably

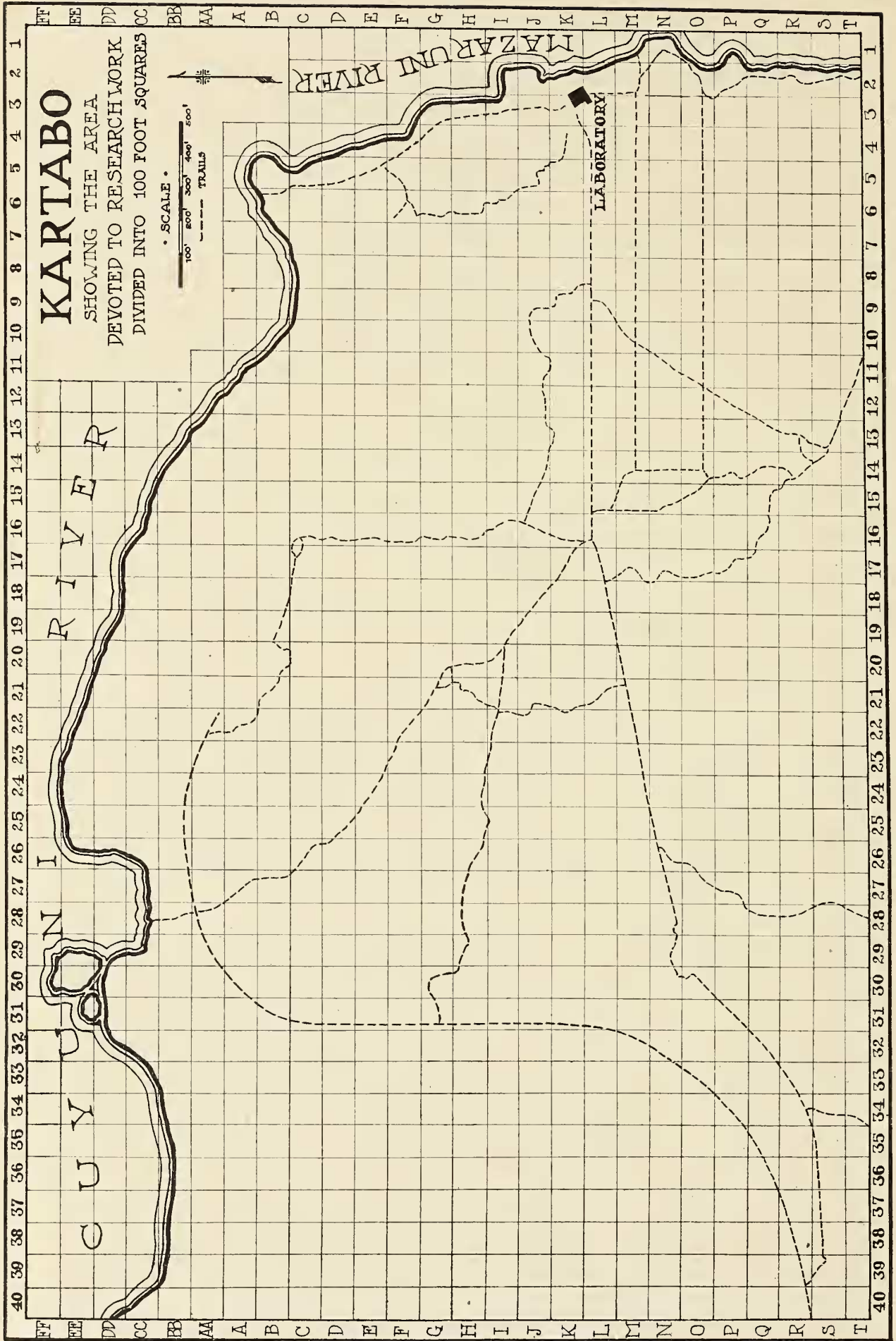


Plate B. Area devoted to research at Kartabo.
 Drawing by John Tee-Van.

nine-tenths of the utterances occur between 5:00 and 7:00 P. M. and 5:30 and 6:30 A. M.

The first note of the call is usually on F natural, and is very sweet and penetrating, with considerable carrying power, being audible for long distances through the jungle. Several times I have heard these birds across the Cuyuni River, almost a mile away. It is a characteristic vocal utterance of solitary birds which inhabit deep woods, taking the place of motion, elaborate plumage, pattern and color of birds which have more of a chance to communicate by sight.

There is only slight variation in the calls of these birds; five individuals, whose notes I studied carefully, were unmistakably distinct; one had an unusually high tone, two others a nasal break, either in the first or second note, a fourth always uttered two, short, preliminary notes instead of a single long one, and the fifth called so regularly from exactly the same spot each evening and morning, with invariably seven notes in its refrain, that there was no doubt about its being the same bird week after week. I shall have more to say of the voice of this bird under courtship.

Natural Enemies: Three times I have found the feathers or other remains of this species in the jungle, once accompanied by the tracks of a margay cat or ocelot, and again by the pugs of some smaller carnivore; another record is of feathers of a tinamou in juvenile plumage, in the stomach of a spectacled owl.

Variegated Tinamou are naturally timid birds with a regular system of escape. When flushed in deep jungle they rise with a sudden rush of wings and scale off for twenty or thirty yards. They then come to earth and freeze for ten or fifteen minutes. If, as rarely happens, their landing place is accurately located, either by actually seeing the bird descend or the leaves moving, it is an easy matter to approach quite close and watch the bird for some time. It never moves while under surveillance, but stands like a bit of mottled jungle debris with its eye full upon the disturber of its peace. Nine times out of ten, the individual flushed evades all scrutiny or search. Even more than *Tinamus major* the plumage of this species merges with the jungle floor. There is no doubt that the birds unconsciously trust to their protective coloring, both in permitting a close approach at first, and in freezing after the escape dash. When one is crashing through dense undergrowth, the birds escape by creeping silently to one side, as I have now and then

observed when crouching at one side and watching the progress of one of my party near by.

Few individuals are free from ticks and *bête rouge*, two or three of the former being often scattered about on the face or between the upper scales of the legs, while the latter pests occasionally form large sores on the occiput and hind neck, with scarlet patches of the mites on the lores.

Once I saw a bird collide with a tree-trunk and fall stunned, although it ultimately recovered. But I believe that such accidents, due to imperfect steering ability, occur more frequently in the large tinamou than either in *Crypturus variegatus* or *soui*.

One bird brought in by an Indian hunter showed all the symptoms of old age,—worn beak, roughened tarsi, skull thicker than usual, and its flesh was unusually tough. I had, of course, no means of knowing how old it actually was.

Natural friends: These solitary birds seem to have no especial association with any other creatures of the jungle; more than once I have seen them stop feeding and look up in alarm at the warning rattle of an ant-bird which had discovered me, but this recognition of the quality of alarm in other birds' notes is common to most of the jungle fraternity.

Food: Of fifty stomachs, all contained vegetable matter, there being, in addition, insect remains. Small berries or fruits form almost the whole vegetable diet, many cherry-like with round pits, wild plums with oblong stones, hard acorn-like seeds, and occasionally fleshy fruits without pits or seeds. Of the four containing animal matter, number one had unidentifiable insect remains; number two, several small beetles and wire-worms; number three, a harvestman and a small beetle, and number four a roach.

All the food is procured on the ground, and the birds in company with accouries have favorite berry trees, under which, at the season of falling fruit, they may be found day after day.

Roosts: Variegated Tinamou are as solitary in their roosting as in other ways; they roost on the ground, or, as in two cases at least, on fallen logs a few inches up. Usually the choice of a place is deep within a tangle of lianas and vines, from which the bird could not possibly take immediate flight. The persistence and lengthened duration of these spots are shown by the considerable amount and limited locale of sign. I have kept close watch on a bird which eventually proved to be female, through a brief period

of intensive vocal courtship, and neither during it nor afterwards did the tinamou fail each night to roost by herself in her solitary tangle.

Breeding: My breeding records of this species, taken as a whole and including breeding adults, half-grown birds and eggs, show an unmistakable correlation with the seasons. They are as follows:

February	0	August	2
March	2	September	2
April	3	October	1
May	7	November	0
June	5	December	1
July	8	January	0

The half-grown young birds must be shifted into their rightful place in the month preceding their capture, and the egg of nest number 107 collected on July 4th with chick ready to hatch, must be accredited to June. There results a low average level for the duration of both dry seasons, and the short wet one, while a well-balanced peak of greatly increased breeding arises during the long rainy season, culminating near its beginning in May.

There are only three months during which I have no record of breeding and these would undoubtedly be filled up if I had more thorough knowledge of the field under observation. The calling of the females during every month would indicate that there is no absolute cessation of breeding, as there is in the case of *Tinamus*. This is undoubtedly directly correlated with the remarkable difference in nesting habits,—the simultaneous brooding of four to twelve eggs of *Tinamus*, and a single laying, repeated several times in succession, in *Crypturus*. The males of these tinamou take full charge of the single egg and the subsequent rearing of the chick. As I have mentioned elsewhere (p. 202) I have found a male, attended by a three-quarters grown chick, incubating a newly laid egg.

I should not like to make any assertion as to a single male taking charge of more than three eggs in succession, but from two-month period reawakenings of vocal calling in the vicinity of a single nesting area, and the number of young secured or reported from that place, I am quite sure that three eggs, one after the other, were incubated. It is interesting to note that the same female, judging from the break in a preliminary note of its call, in the time under consideration, underwent at least three other periods of song develop-

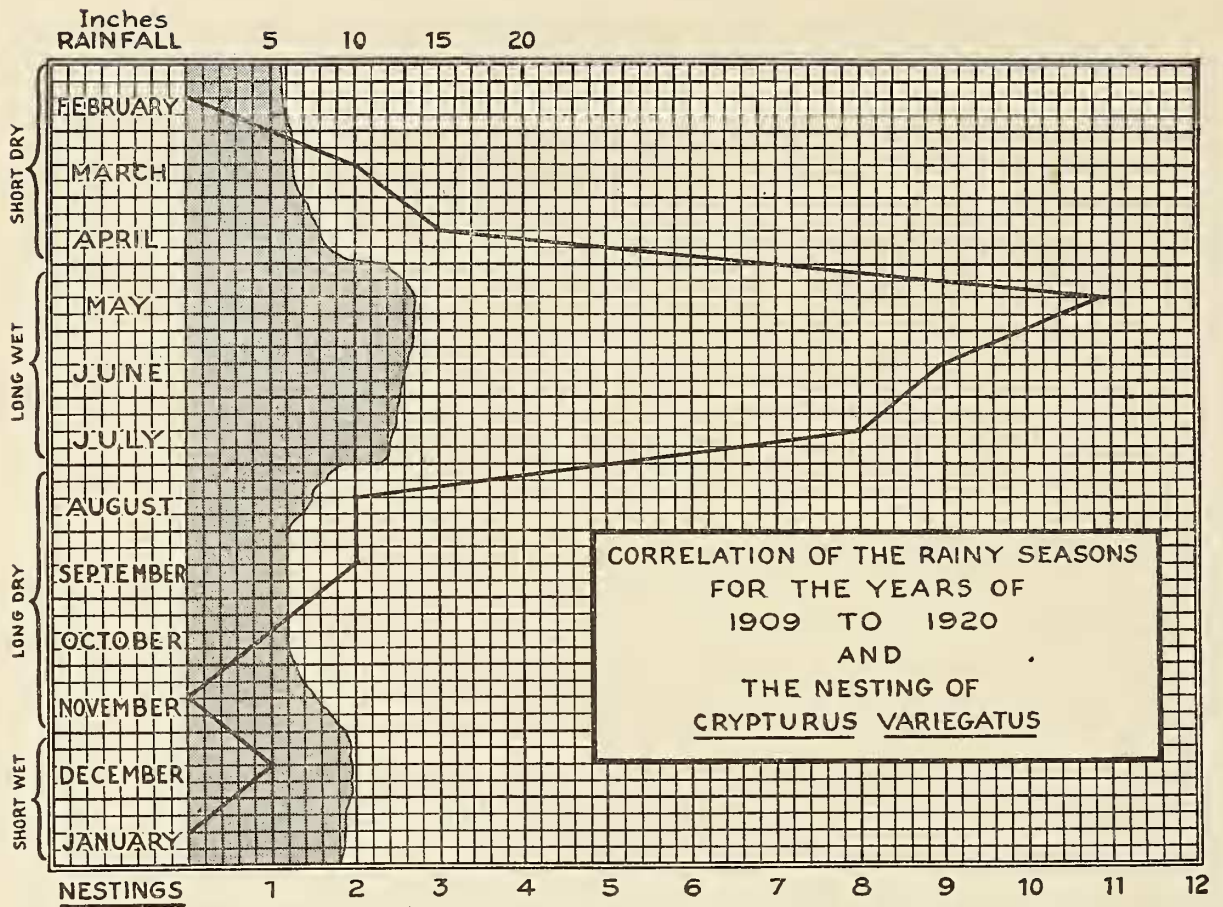


Fig. 18. Correlation of the rainy seasons and the nesting of *Crypturus variegatus variegatus* (Gmelin).

ment in an area somewhat to the northward, and although I could never locate a nest or a brooding male there, it is probable that she was courting if not actually laying eggs for another male bird.

In addition to this instance, at the end of March I have secured a male Variegated Tinamou with one-third of the juvenile plumage still on the body, incubating an egg with a week-old embryo, and twice I have seen half-grown young birds in company with a single adult, presumably the male parent. My early experience with these birds indicated the remarkable proportion of sexes of eight males to one female. I now have a much larger series for comparison, and of forty birds secured within the area under observation, thirty-two are males and eight females, a very exact proportion of four to one. This is very probably the correct percentage.

Almost all of the usual calling is done by the females, while the more excited vocal courtship is wholly feminine. Only once have I ever heard two birds directly answering each other, and on this same occasion I had my first glimpse of tinamou courtship. The male (presumably) was perched on a fallen log near my hiding place,

while an approaching bird (later proven a female) came slowly, by short quick runs, from a bit of open jungle farther west. In the intervals between runs she gave utterance to a veritable ecstasy of calling—the usual dignified, deliberate scale being run and jumbled together, in an excited, high-pitched flood of tone. The male answered from time to time with the usual call, quite unexcitedly; with perhaps several months of brooding cares behind him, and more to come, we can hardly blame him for a restrained, philosophical exhibition of emotion. As the female approached, her runs became shorter and more irregular, her body plumage flattened, the head and neck were raised almost straight, and with rapid, mincing steps, her body vibrating with the effort of the continuous notes, she zigzagged toward the calm recipient of her attention. An abominable ant-bird discovered me at this moment and rattled and screamed his loudest. Both tinamous seemed to perceive me at once, the male slipped off his log, and the female rose in a sharp, twisting spiral and I shot her as she turned, to make certain of the presumed fact that it was indeed the females which did the courting.

A few weeks later I was hidden between two fallen logs waiting for a quadrille bird to return to its nest, when a tinamou walked into view, jigged, I might have said, for the bird was stiff-legged, and taking little mincing steps which shook her whole body and scuffed up the fallen leaves. It was exactly the tremulous heel-walk of an East Indian dancer when, with motionless body, he moves or almost floats across the floor with short, rigid, almost imperceptible jerks. The tinamou revolved slowly, and when her tail came around into view I could hardly believe it was the usual dull-hued species. The tail, or rather the ten, loose-vaned feathers which represent this almost obsolete organ, were upright, thereby pushing up all the elongated feathers of the lower back and rump. Closely applied behind were the under tail-coverts and even the feathers of the flanks, which now, flattened and with much of their surface exposed, proved to be really brilliant in color. With a shaft of sunlight striking them they fairly glowed; the tips of the tail feathers were buffy brown, then came a row of rich chestnut, then two rows of pale creamy buff with semi-circular narrow bands, then a beautiful patch of variegated feathers, white-tipped, with broad black and russet red bars, and finally the softer, black-banded flank feathers. The wings drooped, the tips nearly touching the ground, the beak pointed upward, and the rich cinnamon breast feathers were puffed out.

Three and a half turns did the courting bird make before she pirouetted behind the second log. What followed I did not see. I knew that the least movement on my part would send the bird headlong. My quadrille bird subsequently returned, I learned what I wished about her, and then, stiff from a prolonged squat, I arose painfully. Like a shot, two tinamou were up and bludgeoned off. Not a sound had they uttered, and after the faint scuffling of leaves which continued for a few moments after the bird disappeared, I had no knowledge that any tinamou remained in the vicinity.

The proportion of the sexes makes it almost certain that these birds are polyandrous, although, judging by the slender spatial and temporal bond between them, promiscuous would probably be the more appropriate term. The lack of spurs and the insistence of vocality indicates that courtship and rivalry are carried on in lady-like fashion.

It is difficult to imagine more remarkable contrasts than in the breeding habits of these two genera of tinamou. There are hardly any radical differences, either external or internal, between them, and no specialized characters on the part of the *Crypturus* males to help carry them through the long months of arduous incubation and feeding of the young. The single egg and young are the only factor of amelioration in this unusual achievement. And the life of ease of the female has no apparent compensation, unless it is the need to be so much more on the constant lookout for the dangers to which her continual calling must subject her.

Nesting site: Of six nests found within the quarter mile of jungle under observation, three were in dry, moderately flat jungle, two in somewhat swampy places, and one on a trail half-way up the slope of a low hill. They are apparently chosen without any thought of escape, for in three instances when the bird got up, it either struck against intervening lianas, or had some difficulty in getting away clear. There is little doubt but that the site is chosen by the male; the hen tinamou sticks too closely to her calling place, her feeding and roosting areas to do more than court the male and lay her single egg. Once I was sure of a second site being near a former one. I took an egg in a damp low bit of jungle, and a week later flushed the bird from a new, well-formed, but as yet eggless hollow eight feet distant from the first. He did not however, return after this second alarm.

Nest: No attempt is made to form a nest. Attracted by some

unknown choice, a spot is selected, and is made into a home literally by squatting. If leaves and twigs or other jungle litter are beneath the breast of the bird, they are pressed down and form the sole lining; if not, the mold alone receives the pressure and is gradually rounded into a shallow form.

Egg: A single egg is laid at one time and incubated. Six eggs have been collected from as many nests generally distributed in the Kartabo research area, and these show weights, dimensions and stages of incubation as follows:

30	grams	.....47	×	34.5	mm.	Four day embryo
29	"	.....45.5	×	34.8	"	Fresh
34	"	.....51.2	×	36.1	"	Two day embryo
31.3	"	.....49.5	×	36	"	Full-grown embryo
29.5	"	.....45.5	×	35	"	Seven day embryo
34.2	"	.....50.7	×	36.7	"	Fresh

There is perfect correlation between weight and dimension, but, as is evident from the following table, there is no relation between weight and incubation:

<i>Weights</i>	<i>Average of length and width</i>	<i>Incubation</i>
29 grams	.....40.1 mm.	Fresh
29.5 "	.....40.2 "	Seven day embryo
30 "	.....40.7 "	Four day embryo
31.3 "	.....42.7 "	Full-grown embryo
34 "	.....43.6 "	Two day embryo
34.2 "	.....43.7 "	Fresh

1	1	1
2	2	5
3	3	4
4	4	6
5	5	3
6	6	2

The extreme weights are 29 and 34.2; average 31.3 grams.

The extreme dimensions occur in the two fresh eggs, 47 by 34.5 and 50.7 by 36.7, the average being 48.2 by 35.5, or compounded 41.8 mm.

There is little variation in the color, the surface showing an exquisitely delicate tint which is but poorly expressed in our English



Fig. 19. Nest and egg of the Variegated Tinamou *Crypturus variegatus variegatus* (Gmelin).

term of light purple-vinaceous. There are sometimes zones of lighter tint about the larger or smaller end, due to some physiological cause in the lower portion of the oviduct. I consider the color of *Crypturus* eggs as distinctly protective, much more so than those of *Tinamus* whose turquoise sheen is readily seen against the jungle debris. As such it is at least one ameliorative factor in the risk of the small number, and the danger of the continuously breeding male bird. The birds always sit close, however, and only when almost stepped on, do they boom up and away. Many an egg would go undetected if instead the sitting tinamou would creep stealthily off at the first hint of danger. The gloss of the egg is not quite as high as in *Tinamus*, but it is still far ahead of any other bird's egg with which I am familiar,—one of the most beautiful shells in the world.

Out of the observation area I have known three eggs of the Variegated Tinamou to disappear suddenly long before incubation was completed, but only in one case do I know the cause, when a herd of peccaries trod heavily over the nest and all the neighborhood, a few fragments of yolk-stained shell showing how a single crunch had provided some wild pig with a delicious mouthful.

I have taken a fully-formed, but white and glossless egg from a bird more than half-way down the oviduct, so the pigment and gloss must be added very far down, just before the egg is laid.

Young: Incubation lasts about twenty-one days, and I have two notes, one of my own and the other by an assistant, of nests being deserted twelve hours and twenty-four hours after hatching. The parent therefore has at least the precocity of his offspring to lighten his labors. We have secured two young birds of about two and five weeks respectively, feeding by themselves at a distance from the parent, so the precocity extends to the independent juvenile life, thus allowing the male to take up, unhampered, a new round of domestic duties.

Relation to man: The Indians know the Variegated Tinamou as Orri-orri, and shoot it for food. As to hunting, the account to come under *Tinamus* holds, word for word, for this species as well.

EXTERNAL CHARACTERS

Weight: Adult Variegated Tinamous weigh from 345 to 393.5 grams; or $\frac{3}{4}$ to $\frac{6}{7}$ of a pound. Males vary from 345 to 374 grams; females from 356 to 393.5 with an average of 352 and 372 respectively, giving the dominant sex an excess of almost ten per cent.

Dimensions	<i>Males</i>	<i>Aver.</i>	<i>Females</i>	<i>Aver.</i>	
Total length . . .	291. -325.	310.7	310. -331.	323.	4%
Culmen	28. - 31.	29.8	29.5- 32.	30.7	3%
Width of nostrils	5.5- 6.2	5.9	5.5- 7.	6.4	8%
Eye diameter . .	8.5- 9.3	8.9	8.4- 9.4	8.9	—
Wing	155. -170.2	161.	159. -174.2	165.5	3%
Tail	45. - 50.	47.6	39. - 50.3	47.7	—
Tarsus	42. - 47.	43.8	44. - 48.	45.6	4%
Middle toe only	24. - 27.5	25.3	25.2- 26.8	25.5	—
Extent	515. -540.	529.5	536. -551.	546.	3%

For a sex dominant in courtship, female tinamou exhibit remarkably little specialization of secondary sexual characters; with plumage hardly to be differentiated, the birds show greatest differentiation in weight (10 per cent). In six body characters the females show an average excess of a fraction over four per cent, being equal in eye diameter, tail and length of middle toe.

Fleshy colors: There is little or no variation in the sexes in these colors. Beak, the upper mandible and the cutting edge of the lower are black; terminal half of lower, dusky; remainder of lower, cream buff. Eyelids, citrine drab. Iris, dark chestnut. Legs and feet citrine drab; claws on middle toes somewhat lighter.

Face and eyelids: In the full-sized young bird there are more feathers around the eye than in the fully adult. At first there are two complete rows, while in older birds these are reduced to a short row of about nine to ten minute feathers above and a short double row below.

Oil gland: Low, dark, spreading, truncate, anteriorly superficially divided by a slight crease; with two tufts of down on the summit, or occasionally four in the fully adult, the latter number arranged in the form of a square.

Claws: The thumb is without a claw in the adult; the index finger has a well-developed one, sometimes unworn and curved, or again worn down to a rounded nodule.

Wing graph: The wing is short and much rounded, with a deep inferior concavity; the outline of the primaries in the spread wing forms more than half a circle, while the corresponding outline of the secondaries is a very shallow segment of a circle. There are ten primaries, the outermost or 10th being considerably less than one-half the length of the 9th. A rather unusual condition exists at the

juncture of the two main series of flights; the 11th flight feather, in size, curvature, shape, pattern and follicle isolation is a true secondary, yet in actual position it arises quite distinctly from the head of the metacarpal and not from the ulna. I have chosen, however, to consider it as the 1st secondary which has been carried over the basal limits of this series. There are twelve secondaries, followed by three more feathers in the same linear series, but which are so soft and of such small size that they can take no part in actual flight.

Immature plumage: A two-thirds adult bird, weighing 303 grams, has the top of the head like the adult, except that it is dead black without a greyish cast; short feathers behind the eye and a few on the nape have pale-buff, subterminal, lateral spots; chestnut of the neck and upper mantle are much duller than in the adult. The dorsal contour and upper wing coverts are about one quarter juvenile, and three-quarters post-juvenile. On the dorsal body the juvenile feathers are pale, dull Saccardo's umber. In the last juvenile feather to come in there is a small, central subterminal black spot, below which is a touch of cinnamon buff; the first adumbration of the adult colors. This color is interesting as being an exact shade of darker, more generalized color than cinnamon buff (Ridgway's Color Standards, Plate XXIX, 15" d and 17" k). In the post-juvenile plumage the spot has expanded into a broad, wedge-shaped, subterminal band, wholly bounded by cinnamon buff, the tips of the barbs black. The latest appearing feathers, still partly ensheathed, show the three adult cinnamon buff bands dull but fairly well developed. In the post-juvenile moult the lengthened lower back and rump feathers are developed. On the juvenile tail-coverts, which in this plumage exceed the tail in length, the umber is here so extensive that it encloses a very broad band of the basal block.

The corresponding plumage on a fully adult bird shows the wedge-shape lost, the markings having become straight cross bands, and the feathers themselves much wider and more truncate. There are two solid bands of golden cinnamon buff and distinct traces of a third, all separated by wider bands of black, the distal one being terminal.

The ventral plumage in the immature bird is much more juvenile in pattern than the upper. The breast shows only a sprinkling of adult, self-colored cinnamon feathers, the present plumage exhibiting the juvenile, subterminal, elongated black patch, with the large, rounded, central, terminal white spot. On the lower breast the black

disappears, the white widens to a band, and the basal cinnamon fades until on the abdomen the feathers become pure white. On the sides there is a mingling of pectoral and dorsal patterns, resulting in many combinations of spots and bands, black, cinnamon, buff and white.

On the greatly elongated femoral wing, which is wholly distinct from the lengthened dorsal plumage, the basal color is dull cinnamon brown, with a wide, terminal band of white, bordered by an irregular, dark clouding. This tract extends from the front of the femur quite to the lateral rectrices, and the feathers are 40 mm. in length; they curve around between the thighs and the tail, meeting in midline, tips on, and covering all but the longest under tail-coverts.

The under tail-coverts, are, as in the adult, the most brilliant of the whole plumage, but strangely enough, they are even more conspicuous than in the adult, and when all in position, form very closely defined zones of color. The smallest, basal, anterior feathers are rich chestnut with a wide border all around of creamy buff and an arrow-shaped center of deep black; the following several rows of larger feathers are clear vinaceous buff; the last, largest row is parti-colored, considerably longer than the juvenile rectrices, with worn tips, showing how they have been functioning as tail feathers. Those on each side have the outer webs mostly chestnut, farther in, the black-center-buff-edged type prevails, while the central pair are almost wholly buff.

The juvenile rectrices are ten in number, the longest 41 mm.; the visible areas dull chestnut, mottled with black. Moulting begins with the outer pair, the post-juveniles being almost clear black, with two, wavy but complete transverse bands of golden cinnamon buff, and more or less distinct traces of a third.

This two-thirds grown bird shows four nodes of moulting in the wings. There are ten primaries, eight secondaries, and six tertiaries. The outermost, 10th, short primary is just losing the last basal sheaths of its long delayed growth; the innermost, or 1st primary, together with the 2nd and 3rd are new and full-grown, the latter still with blood at the base; 4th four-fifths grown, 5th a one-inch blood sheath, 6th to 10th old; 1st to 5th secondaries old, 6th just shed, 7th small blood sheath, 8th four-fifths grown; 1st tertiary half-inch sheath, 2nd to 6th old. Thus we see four moultings, in the 10th primary, 1st primary, 8th secondary and 1st tertiary, the two distal being centrifugal, the two distal centripetal.

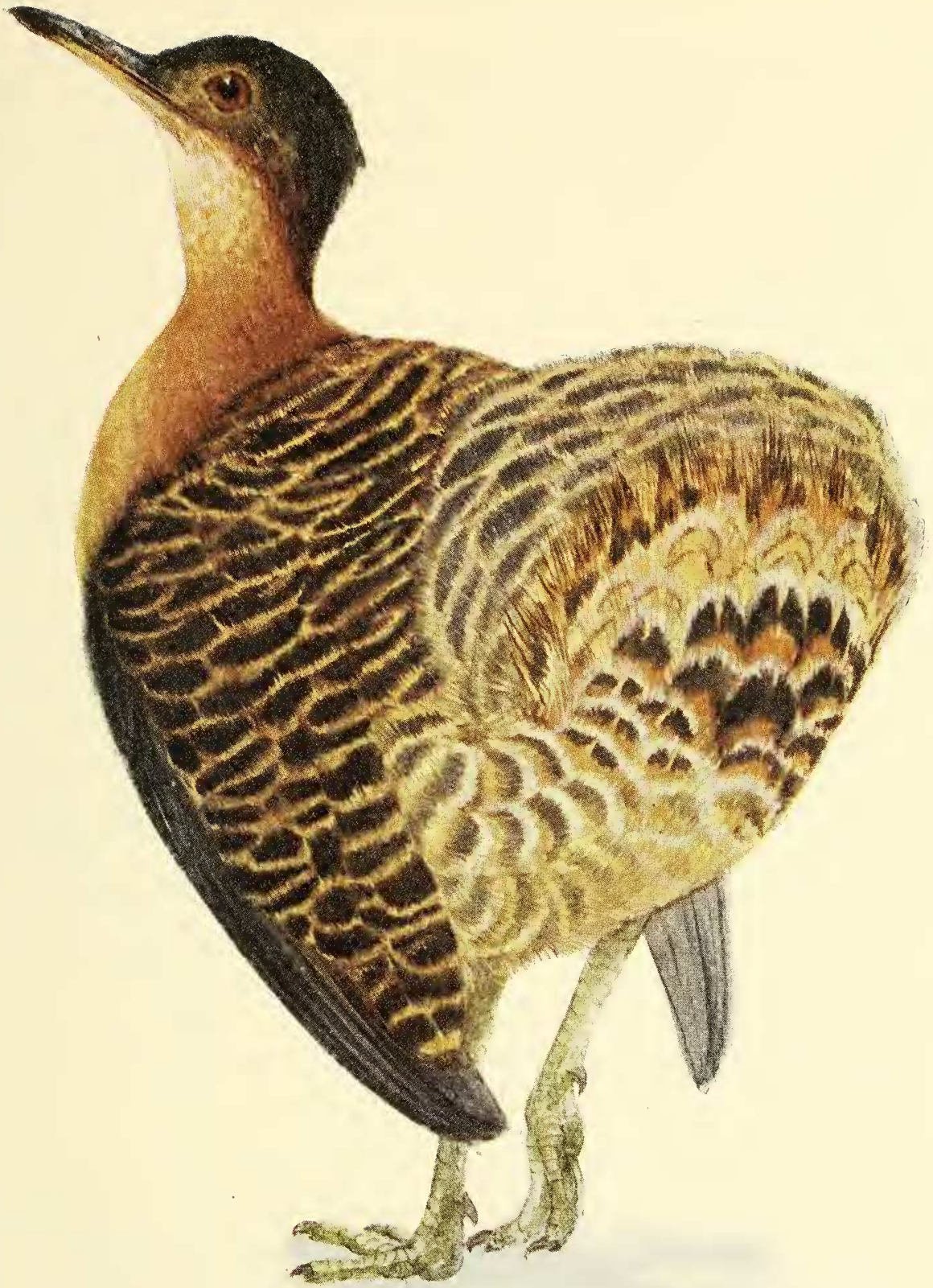


Fig. 20. *Crypturus variegatus variegatus* (Gmelin). Female in the position of courtship.
From a color drawing by Helen Damrosch Tee-Van.

Juvenile primaries have a faint, outer, terminal edge of russet and in the next moult this is reduced to a single subterminal notch of pale buff; the second post-juvenile moult sees the disappearance of this spot, and the primaries immaculately adult. In the juvenile plumage, the only difference in the feathers from the 6th tertiary to the 3rd secondary, is a gradual reduction of the russet on the tips and outer webs, correlated with the amount of exposed surface in the closed wing and a thin line of white along the outer web of the outer secondaries. In the innermost tertiary this russet covers half the entire feather, while in the 3rd secondary it is reduced to a broad, mottled, outer margin. The new secondary moult beginning with the 8th, marks a radical change to the adult, where the feather is wholly blackish brown except for clear-cut mottling along the outer third and a subterminal band of pale golden buff, reaching almost to the rhachis.

Comparison of the relative dimensions of birds in juvenile plumage with those fully adult, reveals some interesting facts. Such a comparison is as follows, with the ratio of percentage of the young birds:

	<i>Juvenile</i>	<i>Adult</i>	
Length.....	244.	310.7	78 per cent.
Culmen.....	24.5	29.8	82 " "
Eye diameter.....	8.	8.9	90 " "
Wing.....	142.	161.	88 " "
Tail.....	40.5	47.6	83 " "
Tarsus.....	41.5	43.8	94 " "
Middle toe.....	24.5	25.3	97 " "
Extent.....	465.	529.5	87 " "
Weight.....	241.	359.5	67 " "

The significance of these figures is apparent when we rearrange them in the numerical order of percentage values. First, and nearest to the adult is the toe length, 97 per cent.; the organs which of all others are of most importance in avoiding danger and seeking food. Closely following and directly connected with the toes is the tarsus, 94 per cent., while the eye, 90 per cent., deserves its high place as the second most important vital organ in the life of these birds. The wing, 88 per cent., comes next and it and its necessary corollary, the extent, 87 per cent., are the chief secondary line of defense when escape by foot is impossible. The tail, 83 per cent.,

is of less vital need, and the beak, 82 per cent., functions as well whether it is a few millimetres shorter or longer. The total length 78 per cent. is of no dominant importance in viability, nor is the weight, 67 per cent. Taken all in all, this table of statistics becomes really vitally significant when we interpret it in terms of the actual life of the organism.

Scalation: *Front*; Twelve to fourteen scales, the uppermost split in two, above this a group of faintly marked scales. *Inner*; Acrotarsium 30, 50, 50, 50, 30, planta tarsi about 20, between these are several rows of irregular diamond and hexagonal shaped scales. *Back*; Many small, irregular, hexagonal pavement scales on upper half of heel, from middle of heel to base of tarsus, ten to twelve scales, lowermost divided into two. *Outer*; Similar to inner, but often with less of acrotarsium, and more of planta tarsi visible.

Adult plumage: Crown of head and nape, black, paling to slate grey on sides of head, crown, forehead and lores. Ear coverts blackish brown; chin and throat, white; neck, dorsal and sides, chestnut; neck below, tawny, shading into cinnamon on mid-breast, and cinnamon buff on lower breast, many of the feathers faintly ringed with both hues. Mantle, back, wing-coverts and tail and sides of body, black, barred on mantle and back with a sub-terminal and terminal bar of golden cinnamon buff, the terminal bar changing to pinkish buff on the wing-coverts, longer tail-coverts and sides of body, and into greyish white on the flanks. Under tail-coverts variable, russet toward the base, followed by more or less black and tipped with pinkish buff.

Alula feathers along front edge of wing, primary coverts, primaries and secondaries, blackish brown; secondaries barely edged with pinkish buff on the proximal outer edge of outer web. Lower breast merges posteriorly into pinkish buff and on middle abdomen to greyish white. Tail feathers, neutral grey, with faint irregular terminal mottlings of russet and black.

Powder downs: In this *Crypturus* these tracts are dorsal and paired, consisting of two elongated patches down each side of the back, beginning 15 mm. back of the tips of the scapulars and ending at the antero-lateral base of the oil gland; each patch is a dense growth of long, greyish-white down, 15 mm. wide in front, narrowing to eight posteriorly, and 70 mm. in total length. These feathers penetrate the skin more deeply than the bases of the contour plumage, and lie almost flat, arranged in seventeen lines, a double row of feathers in each line.

Aftershaft: This structure is well developed on the contour plumage, the length averaging more than half the total length of the feather.

Parasites: Like all animals of the jungle floor, these birds suffer considerably from the attacks of *bête rouge*, those ever-present, larval *Thrombidium*, which attach themselves in great numbers to the more inaccessible portions of the body, such as the lores, ear openings and especially the rear crown and nape. The feathers here are sometimes quite worn away, or their follicles destroyed by the dermal irritation set up by the masses of mites. A tick is occasionally found clinging to the aural aperture, but these creatures offer little inconvenience.

Mallophaga are moderately abundant, but always present. On one individual I have found an elongated species, with spade-shaped head, and a series of lateral, brown sclerites which do not meet across the abdomen; together with another species, a broad-bodied, reddish-bordered insect, with large head, with wide and backwardly-directed horns. The latter are about ten times as abundant as the former.

Nematodes of two small species are present in almost all tinamou, while tape-worms are much rarer. I have taken one of the latter, one hundred millimetres long, with one hundred and fifty segments, from an immature female bird.

INTERNAL CHARACTERS.

Pecten: 2 mm. high; 6.5 long at base, 3 mm. at summit; twenty-three folds. Eye-ball 16.5 mm. in diameter.

Palate: Palatine fissure very far back; no denticulations on palate; the fissure has narrow, parallel sides for the anterior three-fourths of its length, expanding posteriorly.

Tongue and glottis: The tongue is very simple, triangular, with the longest arm in front, blunt, fleshy, posterior cornua with a gentle curve along the posterior side; tongue length 8, width 7 mm.; mandible length 53, width 17 mm. Glottis immediately behind the tongue, a well-developed epiglottid fold intervening; the opening long and parallel-sided, with rounded ends, no denticulation.

In a half-grown bird the tongue has much terminal pigment; the dimensions are length 7.5 mm. by 5 mm. broad. Faint lines along the posterior edge of the tongue and around the glottis may indicate vestiges of buccal teeth.

Syrinx: Extrinsic muscles arise at the 18th tracheal ring, where they close at once across the entire trachea, forming a nearly opaque sheath of muscle which extends quite to the larynx, slightly thinning as it goes; the fibres of one side of the overlapping extrinsics are usually dominant and overlaid upon the other; usually the left-hand ascending fibres overlie those of the right, before merging in the general longitudinal sheath. The free part of the extrinsic is about 25 mm. in length, very broad, 3 mm. in width, and curves around the lateral portion of the trachea as a curved sheath; farther on it narrows to 2.5 mm. in width and continues as a very thin ribbon-like muscle to its attachment on the sternum. Posteriorly almost all the fibres of the extrinsics extend on up the sides of the trachea, the extension across the centre being much thinner than in front.

The intrinsics are absent; posteriorly a very thin transparent, silvery, tendonous sheath extends down the centre of the trachea, covering more than half its width from the juncture of extrinsics to the syringeal collar; it here divides and is continued down the bronchi to the lung tissue, hence it may be considered as a second pair of extrinsic muscles.

Underlying this tendonous tissue is a very thin layer of muscular fibres, which increase slightly in density on the syrinx proper, but are wholly insufficient to manipulate the internal vocal pads. This posterior layer does not extend down the bronchi, but exhibits an abrupt attachment at the 1st tracheal ring, and passes in a solid sheet on to the oesophagus.

The tracheal length from the larynx to the 1st tracheal ring is 105 mm. Just back of the glottis the trachea is enlarged, but after a short distance the calibre rapidly becomes smaller, remaining so as far as the insertion of the extrinsic muscles. Here it again enlarges into an elongated cartilage box extending to the syrinx proper. The diameter behind the glottis 5 mm., midway down the neck 3.3 mm., largest diameter of the cartilage box 4.4 mm. The trachea is round throughout except for the box which is slightly compressed.

There are 125 to 130 rings from the larynx to the 1st tracheal ring. These are moderately wide and even-edged, with very rarely any traces of median thinning. Usually they are of the same calibre throughout, averaging half a millimetre in breadth, and they lie close together, separated when contracted, by an eighth to a third

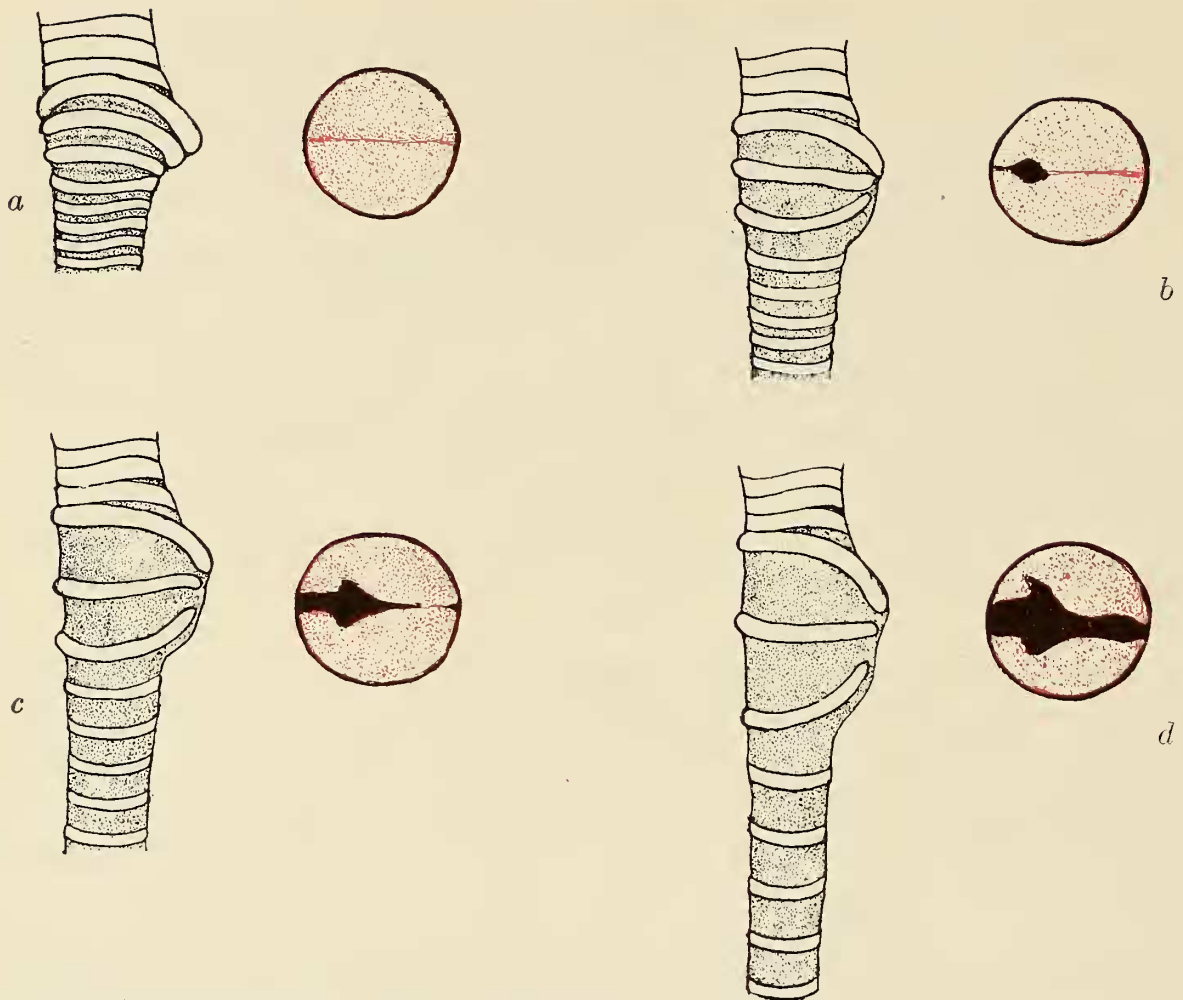


Fig. 21. Syrinx and cross-section of the bronchi of *Crypturus variegatus variegatus* (Gmelin). When the aperture is widest, the lowest note is produced. The gradual variation of the aperture is shown in *a, b, c, d*.

of their width of membrane, and when stretched, being only half their width apart.

The first change in character is at the level of insertion of the extrinsic muscles. From here the diameter increases and then decreases again to the syrinx, so that the trachea here assumes a slightly swollen, bulbous appearance, with an increase at the greatest diameter of almost 50 per cent. This diameter is reduced to 4 mm. at the upper neck of the syringeal collar. Another change is the still greater reduction of inter-annular membrane, so that this is practically, as I have said, a cartilaginous box, with extremely little mobility. An interesting thing is the frequent presence of numerous angular granules of dark pigment scattered along the fine membrane joints of this box, often extending on to the syrinx proper and even over the extrinsic muscles.

This specialized area begins about the 20th tracheal ring. At the level of its greatest diameter, the 7th ring shows a very slight downward bend anteriorly, and this increases rapidly in the succeeding rings, the sides maintaining their narrow calibre. In the 4th and 3rd rings, there are wide, triangular, downward projections in front, while the 2nd and 1st rings become again equal in breadth throughout. This last ring has a very steep downward slope and forms the arch of the bronchi.

The anterior ends of the 1st bronchial semi-rings articulate at the arch with the apex of the 1st tracheal ring, and in fact are closely connected with that ring throughout; in the relaxed, unstretched trachea the 2nd pair of semi-rings also concentrate at the arch and extend slightly obliquely upward from that point; the anterior ends of the 3rd semi-ring in their turn, lie as closely as possible to the arch, and extend out nearly horizontally. In the fully stretched syrinx the 2nd semi-rings are the horizontal ones, resulting in a considerable extent of membrane between these and the 1st semi-rings. The 3rd pair of semi-rings, in this extended condition, shows a very strong, downward curve at the sides, the anterior ends reaching up with their elongated tips toward the arch. There are thus two very wide expanses of membrane between the first three pairs of semi-rings.

The first four pairs of semi-rings are seen in their most normal relationship only in the fresh, relaxed syrinx. They are rounded and rod-like, in pronounced contrast with the flattened rings above, and semi-rings below, and are much longer than the neighboring rings, projecting considerably in front, often with a diameter of a third greater than the antero-posterior diameter of the tracheal box above. The anterior bellying is due to the projecting and overlapping ends of the first three pairs of semi-rings. There are sixteen undifferentiated semi-rings ending in the lung tissue, making twenty altogether.

Posteriorly, the structure of the syrinx is quite as simple as in front. The 1st tracheal ring and often the 2nd is broken. These, together with the ends of the 1st and 2nd semi-rings, are, as in front, all rather concentrated toward the bronchial arch, lying in two parallel rows in a sort of elongated, median groove which, were it a single sheet of membrane, might be called a bronchidesmus.

The exact method of voice production in this bird, is, I believe, unknown, and as long as only alcoholic specimens were available

there was slight chance of its being demonstrated. Acting on my accidental discovery, in the case of *Ibycter americanus*, of the possibility of reproduction of the whole vocal gamut by manipulation of a decapitated specimen, I attempted a similar feat with *Crypturus*. With four individuals I had no results whatever, and my efforts with the fifth were half-hearted, but met with instant success. Holding the bird on its back, and seizing the neck firmly, I stretched it to full extent and struck a sharp blow on the side of the breast muscles. At the second attempt I obtained a clear, high note, which if prolonged, would correspond exactly to the first long-drawn-out note of the bird's call. I repeated this several times, and then by slightly relaxing the tension I extracted a higher note, and so on until nothing but a shrill hiss of air came through the almost closed syrinx. This mechanical stretching and contraction of the respiratory organs followed the natural movement of the bird's neck when it was calling, the head and neck being drawn slightly downward as its notes rise successively higher in the scale.

The physiological method of voice production is seen clearly if the trachea be amputated just above the syrinx, and the latter held upright under a low-power lens. With a forceps grip at the edge of the trachea and another on the lowermost semi-ring of one of the bronchi, we may approach closely to a realization of the *modus operandi* of vocality. To reverse the sequence of tones, if I allow the structure to shrink together by its own weight, and then look directly downward, the bronchus is seen to be completely closed. A barely distinguishable seam extends straight across the center of the lumen. At a slight pull on the trachea, a tiny rounded opening appears in the seam, considerably nearer the posterior aspect of the syrinx; another pull and this widens, extending as a broad, open band quite to the posterior rim, and tapering anteriorly to a point more than half-way across the bronchus. The area of the original rounded opening opens out laterally into two flange-like windows. Again a tug, which takes up almost all the slack, and the vocal slit extends across the entire diameter, the lateral projections having become wider, almost wing-like. The plate (Fig. 21, *a*, *b*, *c*, and *d*) demonstrates these four phases far better than any mere description. No matter how little or much stretching tension is applied, only the syrinx and bronchi are affected; the tracheal box being quite immobile from the 1st tracheal ring upward.

There are two large cartilaginous cushions or partitions on each

side of each bronchus, the separation of which medianly is brought about by the extension of the syrinx and bronchial tubes. The most careful examination of this internal tissue reveals no trace of muscular fibre, only very soft elastic cartilage, of exactly the right mobility and elasticity to separate and close at the will of the external muscles.

A longitudinal section of the syrinx and upper bronchus shows that the lateral wing-like extensions in the partially open bronchus are due to a contracted area in the cartilage at that point. Even in the closed condition this division is very conspicuous on the inferior profile, and in this we have a clue as to the actual production of these lateral openings. The cartilages are thick and rounded, while on the outer and inner walls this tissue extends, as a gradually thinning sheet, down the bronchus. When the bronchus is stretched, these tracts are drawn down, the rounded, constricted syringeal cartilages are somewhat rotated inward, toward one another, and the ventral constriction, also rotating inward, produces a mutual gap, rounded at first, and extending more and more laterally as the stretching tension and rotation are increased. There is no marked difference either in the analogy or homology of this phenomenon in juvenile and adult tinamous.

Syringeal Variation: I have described an average, normal syrinx, but examination of several dozen of this species reveals a number of individual variations, showing that there is a slight latitude in the architecture of the organ which produces very similar sounds.²

A progressive tendency due to age is an increased ossification of the lower tracheal rings, both in front and behind. In the juvenile syrinx of two individuals the 1st tracheal ring was not quite connected anteriorly, making it actually in these isolated cases, the 1st semi-ring; posteriorly in three young birds the lowermost three tracheal rings were all broken, while in one juvenile bird, four tracheal rings were broken behind. As a rule in the adult the 1st tracheal ring is complete anteriorly and posteriorly the 1st and 2nd tracheal rings are broken. In old birds the 1st tracheal and the 1st semi-rings may be united by an osseous bridge across the anterior centre, rarely with a foramen in the middle, or, as in two extremely old females, the 1st bronchial, and the 1st and 2nd tracheal rings may be solidly fused in front, while posteriorly, very rarely, even the 1st tracheal ring may be solid.

² See page 216 for variation in the voice of *Crypturus*.

Visceral anatomy: described from adult female, W. B. Coll. Vert. No. 591. The flesh is pale greyish-green in color.

The crop is large, about 15 mm. in diameter when partly filled, and lying in the inter-furcular hollow; liver large, capping the gizzard, the lobes somewhat unequal, the left the larger, 24 mm. long, the right being 29; the left sends down internally a 10 mm. lobe, lying on the gizzard, while the projection of the right lobe is narrower but slightly larger, and applied to the side of the gizzard. The proventriculus is 25 mm. long and 11 in diameter. The gizzard is large and its anterior edge is turned slightly toward the right, dimensions 36 long by 34 deep by 22 wide. The lining of the proventriculus is loose and about to be shed, thin, white, and filled with large, vacuole-like glandular pits; the gizzard lining is also ready for sloughing; it is dark brown, rough, with numerous irregular cracks and pits, much like the bark of a chestnut tree.

The small intestine has an average diameter of 5 mm. and the remarkable length of 1030 mm. ($40\frac{1}{2}$ in.); the large intestine is 10 mm. in diameter and 85 mm. ($3\frac{1}{3}$ in.) in length; the caeca are extremely large, elongated lobes, constricted at the neck and increasing in girth to the extremity; they are 5 to 15 mm. in diameter and 75 in length. The large intestine and caeca are darker in color than the small intestine.

Heart moderate in size, 17 mm. long by 14 wide.

Chick of *Crypturus variegatus*.

On June 9th, 1922 a single egg of the Variegated Tinamou (set number 234⁰/₁) was taken from a nest on the ground in the jungle in S₁₇. It was light purple-vinaceous with the usual highly polished surface, weighing 33 grams, and with the dimensions 47.3 by 35.6 mm. As well as I could determine through the dense pigmentation, the embryo was five or six days old. The egg was placed in the incubator in a temperature of 100 to 103 degrees and dampened and turned regularly.

Sixteen days later, on June 25th, the egg was pipped at ten o'clock in the morning. Two hours later the chick was out, partially dried and creeping about all over the shelf. It was a male, as was ascertained later, weighed 16 grams, and the two pieces of egg-shell weighed 2 grams. A very considerable residue remained in the small end of the shell and weighed 2 grams more. Compared with *Tinamus major* these weights are as follows:

	<i>Tinamus</i>	<i>Crypturus</i>	
Egg.....	53	33	62 per cent.
Chick.....	38	16	42 " "
Shell.....	5	2	40 " "
Adult.....	1133	362	32 " "

The shell was broken by direct outward pressure of the egg-tooth at twelve distinct places around a very straight line, exactly 10 mm. or one-fifth of the total distance from the large end.

The dimensions of the one day chick compared with the average of twenty-eight adult males are as follows:

	<i>One day Chick</i>	<i>Adult Male</i>	<i>Chick's Dimensions</i>
Total length.....	103	310.7	33 per cent.
Culmen.....	12.5	29.8	42 " "
Width at nostrils.....	3.4	5.9	57 " "
Eye diameter.....	5.8	8.9	65 " "
Wing.....	23.5	161	14.5 " "
Tail.....	20	47.6	42 " "
Tarsus.....	19.5	43.8	44 " "
Middle toe only.....	16	25.3	63 " "
Extent.....	90	529.5	17 " "

The most significant fact in this table is that the three dimensions in which the chick reached more than 50 per cent. (width of bill 57 per cent., eye diameter 65 per cent. and middle toe 63 per cent.) are of organs of apprehension, of sight and of speed, the three most necessary qualities in the life of the newly hatched chick.

The beak is pinkish grey, shading to fuscous on nostril tube, gape and tip; the bare portion of the lower eyelid is light purplish grey, the very narrow fleshy eye rim dull olive brown; iris dark hazel; legs and feet yellowish buff touched with pink, heels and sole pads dark purplish grey, tips of toes and upper half of claws grey, claws cream color.

There are numerous, small, golden, tawny down feathers around the eye, a single row in front, increasing to three or four at the back; the upper lid is densely feathered with normal head down, upper half of lower lid bare, lower half fairly densely covered with bristly tipped down.

Oil gland conspicuous, flat-topped, deeply bisected, surmounted

with three tufts of down, dark and slender at base, fluffy and pale buffy at the tips. There are small but perfectly distinct claws on the pollux, and large, well-developed, subterminal blunt ones on the index fingers.

The egg-tooth is low, not very sharp, and at the extreme tip of the upper mandible. It spreads out into a large, flat base, extending one-sixth of the total length of the culmen. It is an ideal pressing tool, the pressure force being distributed over a large surface of the soft beak.

The position of the chick in the egg is also very obviously an adaptation to facilitate shell breaking. The neck and head are folded close to the breast and abdomen, while the right leg is raised far forward and sideways until the beak rests directly on the under side of the flexed tarsus. Pressure is thus brought to bear on the shell not only by movements of the head but the slightest effort at extension of the leg and foot automatically forces the beak in general and the egg-tooth in particular against the inner wall of the egg-shell.

A very deep lateral groove begins near the tip of the maxilla and extends back to the nasal fossa. The nostrils are large, with a light-colored operculum covering half of the deep opening, and extending back into a conspicuous, swollen tube, directed slightly upward.

A very deep groove on the mandible pinches off the swollen median portion extending along the gonys quite to the rami, corresponding in size and position to the area shut off by the groove on the maxilla.

In the wing of the newly hatched chick, five primaries are already so far developed that the prenatal down is supported on their tips well above the skin. On the morning of the third day when the chick died, these feathers showed very considerable additional growth. There are in all nine primaries visible. The outermost or 10th is well developed but short, the next five are very long, and the inner three are short. The average length of the five long ones is 6.3 mm., of the four short primaries 3.6. The 1st primary is not distinguishable except as down, and the same is true of all the secondaries.

A typical mid-dorsal down is 18 mm. long, and consists of about twenty barbs, which are simple and spring mostly from the basal sheath, although a main shaft is distinguishable, with several shorter side barbs. The barbules are long and very fine and silky, and of

equal length throughout, dying out abruptly and leaving a long bare tip. They are greyish white at base, black throughout the middle length, and suddenly and strongly tawny red on the last distal barbules and the long terminal shaft.

The tail down is surprisingly long, both in front of the oil gland on the lower rump, and behind it where the future rectrices will appear. In fact a semi-circle of sixteen or twenty large down curved along the tail area are unusually strong, and may be twenty-three mm. long, the tips curved conspicuously around and down, giving the chick an appearance unlike any other young bird. This tail down is decidedly dendritic, with only six or eight barbs arising basally, the others branching from a thick main shaft, which only near the summit trivariates into barbs equal in size to the others. The barbules differ from those of the dorsal down in being shorter, farther apart, standing out from the barbs at wider angles, and also in giving the appearance of a radial rather than a bilateral arrangement. The whole down is solid russet in color.

The Scallation resembles that of the adult as regards the larger scales of the acrotarsium and plantar tarsi, but the outer and inner aspects are much simpler, with far fewer scales than in the old tinamou. Front: fourteen scales, the top three broken into two or three; inner: acrotarsium 40, 40, 50, 50, 60, and 20 per cent., plantar tarsi 50, 50, 40, 40, 30, and 30 per cent., the narrow slit between forming a simple out-bent fold of skin; back: twelve plantar tarsi scales, beginning on heel, lowermost split into three, nine hexagonal, irregular scales down inner side, which might be considered as a scale row of the inner aspect; outer: 10, 40, 50, 50, 50, 50, and 60 per cent., plantar tarsi 20, 20, 20, 20, 10 per cent., the remaining surface covered with two, or for a short distance three, rows of small hexagonal scales.

Plumage: The chick of *Crypturus variegatus* is much more brilliantly colored than that of *Tinamus major* and the body pattern is simpler. Taken as a whole, the colors are curiously reversed, the dark chestnut back color of *Crypturus* being ventral and lateral in *Tinamus*, and the golden tawny of *Crypturus*' breast being found on the back of the larger chick.

The forehead of *Crypturus* back almost to midcrown, a broad band over the eye and back to the nape, together with the facial down, tawny olive, becoming lighter and more silvery well back of the eye. The basal half of the loreal down is black, giving this area

a dark appearance. At the posterior corner of the eye a narrow band of bay extends backward over the ear-coverts, widening on the side hind neck and merging with the dorsal color. This is bordered narrowly with black. The crown and upper nape are bay, except for a median spot and a narrow irregular line of tawny olive which begins on the mid-crown, well behind the forehead color, and extends medianly back to the hind neck. The entire upper and lateral body down is uniform bay or dark chestnut, reaching well down in front of the wings, including the lesser wing-covert down and the more dorsal elongated tail down. It is separated laterally from the ventral colors by a well-marked line of black. The chin and throat are whitish, becoming ochraceous tawny on the breast, lower sides, flanks and thighs. The side breast is deeper tawny and the abdomen paler buff. The greater mass of tail down is russet. The greater wing-covert down is ochraceous tawny, the sprouting quills blue-black.

Biology of *Crypturus* Chick: The chick pipped the shell at ten in the morning and, as I have already related, was out and partly dried at noon. The down dried well except on the back and head, until I put in a circular band of flannel, into which the chick crept and by rubbing around as it would under its parent's plumage, the dorsal down dried fluffily. There is no doubt that the young bird would never dry well without the constant friction of the old bird's feathers during the first twelve hours after hatching. This condition of the down is apparently a rather serious thing, for when the down dries flat and matted together, it causes such irritation that the little chick wastes much time and strength in trying to preen the bad places. Even a slight thing like this might very well be a matter of life and death, at a time when every moment of learning to correlate eye and beak is of the utmost importance.

I observed that the banging of the incubator door caused instant fear reaction—the chick squatting at once, but no other observations were made until the following day at ten in the morning when it was taken into the compound in a vivarium.

Placed on the ground the *Crypturus* chick twice showed fear reactions, and then perched of its own accord. I worked with it off and on all day, and at last it took four small pieces of worms. On the whole it was far less apt in learning to calculate distances than *Tinamus major* of equal age. This was so marked that I believe it to be another example of very delicate balance between necessity



Fig. 22. Three day chicks of *Crypturus variegatus variegatus* (Gmelin). Lateral and dorsal views, natural size. From a color drawing by Isabel Cooper.

and practice. In *Tinamus* there is a single adult to look after a brood of six to ten, while the solitary *Crypturus* chick has the whole attention of its parent, so there is far less need for extreme precocity in this case than in the former. With only a single chick to look after, greater care will be taken, and more time devoted to feeding and guiding the offspring. In *Tinamus* the young are compelled to forage more on their own, having the disadvantage of only a fraction of parental solicitude.

Another characteristic peculiar to this species in comparison with *Tinamus* is its relative silence. The other chicks, or even one by itself, were always cheeping or calling, whereas this one utters only very low calls and at infrequent intervals. Even these are given only when the bird is quiet and undisturbed, and seem to be more of the nature of content calls than otherwise. It is readily seen that it is important for a covey of chicks to keep in touch with one another by frequent calls, whereas a single chick following its parent could with safety do so in comparative silence.

The *Crypturus* chick learned the use of its legs and by two P.M. could make its quick, short spurts without falling over at the end. It never walked slowly more than a step or two, but usually after several futile pecks at the bit of worm which I proffered, if it heard a sudden noise, it darted swiftly away for one or two feet and squatted flat. I tested it with various sounds and found that I could cry out loudly, or clap my hands together near it without effect, but the least deep or hollow sound, such as striking the glass side of the empty vivarium, caused it to jump and flatten. Its pecking, as in *Tinamus*, was always forward and downward at the ground, and its constant fault was to strike beyond the object aimed at. The chick was uncomfortable on a white handkerchief and scuttled to bare ground as quickly as possible. It pecked at worms and spiders much more readily on the ground, even when they were of the same color as their surroundings, than when they were laid conspicuously on light bamboo leaves or when held in the forceps.

I tried calls and whistles with no apparent effect, until I imitated the note of *Crypturus* itself. Like a flash the chick turned in my direction, ran six feet toward me, and crouched beside my foot. I tried it again and again, then summoned the members of my staff to watch. The shrillest whistle brought no response, but the very first note on G sharp above middle C, attracted and held the little

bird's attention, and the following notes brought it headlong. After such a reaction it was much more alert and willing to attempt another bit of food, and not only this, but its sense of direction was all but perfect. When I held my face close to the ground and called, the chick ran, not only toward me, but stopped at my mouth, although I had finished calling before it reached me.

This instinctive and perfect reaction to the call of the species, together with its disregard of the call of *Tinamus* and other terrestrial jungle birds, was wholly unexpected. I have known chicks of other groups to crouch instinctively at the cry of a hawk, or the alarm note of their own or other birds, but to recognize among many other imitations, the exact summons call was very interesting, and threw a new light on the instinct reactions of this very generalized type of bird.

It did not enjoy being in the hot sun, but ran with quick darts toward the shade. Like the other tinamou chicks it never showed the slightest fear of our, to it, enormously tall figures stalking about. In fact, if anyone passed while I was attempting to induce it to eat, it invariably rushed off and followed them and had to be brought back and started over again in food interest. Unlike the *Tinamus* chicks no shuffling of hands or feet in scratching motions and sounds had any effect.

Like so many of the small creatures I have watched in the laboratory compound, the chick persisted invariably in working toward the east or north-east. Again and again I turned it about and always it changed direction and started back. I place no special significance at present upon this, but present it as an interesting fact, as applying to mammals, birds, reptiles, amphibians and even to armored catfish. When, however, I gave the parent's call, the chick never failed to turn and run toward me, regardless of direction.

While it learned to peck and swallow bits of food and quartz with fair accuracy, I could not give it the constant attention and encouragement which it needed, and it died on the third day.